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ABSTRACT

Although a great deal of attention since the late 1970s has been given to the masculine construction and practice of science, this critique has not completely entered the realm of school science. To the extent that it has, it has largely been deployed to depict the disadvantage that female students find themselves at as they negotiate within this curricular realm. Some work has focused on male students' constructions of masculinities and their often deleterious effects in the classroom, but it has not specifically addressed the school subject of science. This paper interrogates what this masculinized image and structure of science means to boys--then by extension, to girls as well--in our science classrooms. Using data gathered during primary school science lessons, some of the ways in which school science serves to recapitulate a middle class, hegemonic version of masculinity is examined. Whereas the literature around the formation and expression of working class masculinity stresses the importance of the "physical" in coming to a true masculine identity, school science serves as a nice example to illustrate how a middle class version of masculinity focuses on the mind rather than the body. Some implications for the discipline of science and for science classrooms, both in terms of the structure of the school science curriculum and the pedagogies used to convey that curriculum, are also discussed. (Contains 85 references.) (Author/NB)

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Boys will be boys
(If they pay attention in science class)

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Paper presented as part of the symposium Boys and Schooling: Shifting Frames and Masculinities at the Annual Meeting of the American Educational Research Association, San Diego, CA, 17 April, 1998.

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ABSTRACT

Although a great deal of attention since the late 1970s has been given to the masculine construction and practice of science, this critique has not completely entered the realm of school science. To the extent that it has, it has largely been deployed to depict the disadvantage that female students find themselves at as they negotiate within this curricular realm. Some work has focused on male students' constructions of masculinities and their (often deleterious) effects in the classroom, but it has not specifically addressed the school subject of science. This paper interrogates what this masculinized image and structure of science means to boys (and then by extension, to girls as well) in our science classrooms. Using data gathered during primary school science lessons, I examine some of the ways in which school science serves to recapitulate a hegemonic version of masculinity that is middle class. Whereas the literature around the formation and expression of working class masculinity stresses the importance of the "physical" in coming to a true masculine identity, school science serves as a nice example to illustrate how a middle class version of masculinity focuses on the mind, rather than the body. I conclude with some implications for the discipline of science and for our science classrooms, both in terms of the structure of the school science curriculum and the pedagogies used to convey that curriculum.

> The research forcibly shows– in contrast to much popular thinking– that "boys" are not a homogeneous bloc, that masculinities vary and change, and that in gender, institutions (as well as bodies) matter.
>
> –Connell, 1996, p.230.

> Postcolonial histories and studies of contemporary projects have shown that in important respects modern sciences and technologies, no less than other cultures' traditions of systemic knowledge, are local knowledge systems.
>
> –Harding, 1998, p. 55.

This paper is a theoretical exploration of the ways in which school science structures and is structured by middle class norms of masculinity. It arose out of an interest in how participating in school science can serve as a masculinizing practice, and how students construct identities that are consonant or at odds with this practice. Data from elementary classrooms are used to provide support and examples for the claims I make. Although an extensive research base exists about the gendered nature of science, and an increasing research base is accruing about the ways in which schooling is complicit in the constructions of certain kinds of masculinities, this paper seeks to examine the intersection of these research programs– namely how school science reinforces masculinity in ways that are neither monolithic nor unambiguous.

My approach reflects on what this gendered school science means for boys– both in terms of opportunities granted and opportunities foreclosed. I am interested not in why girls reject school science, but a different side of the same coin– specifically, why do some boys continue to embrace it. I examine not only the curriculum and classroom materials used in school science, but also the ways in which these are deployed pedagogically. I am interested in how schools teach science, what science they teach, and how they teach *about* science. To this end, following Davies' (1995) call, I intend for this study to offer a clearer picture about the ways in which school science fosters the propagation of certain hegemonic masculinities by turning attention to, "the mythologizing practices that create the sciences as hard and male and objective" (p. 9).

Gendered science

The relationship between science and gender has been much explored since the feminist critiques in late 1970s. Theoretically, researchers have critiqued science (and technology) for its androcentric epistemology (Harding, 1991), sexist language (Keller, 1985, 1992; Merchant, 1980), and masculinist structure and methodology (Bryson & de Castell, 1994; Easlea, 1983; Harding, 1986, 1993; Kelly, 1985). This Enlightenment science, the science still embraced in the Western world and taught in our schools, continues to function as a regime of truth (Foucault, 1980). And far from being objective, a-cultural, and value-neutral, the feminist, anti-racist, class, postcolonial, and queer critiques of science have revealed it to be just the opposite. As Sandra Harding writes, "Abstractness and formality express distinctive cultural features, not the absence of all culture" (1998, p. 61).

Such positivist science is rooted in an internalist epistemology that locates the success of modern science in its internal features– "experimental methods or scientific methods more generally, science's standards for maximizing objectivity and rationality, the use of mathematics to express nature's laws, the distinction between primary and secondary qualities in nature, or some other" (Harding, 1998, p. 2). Modern science embodies what Dale Spender (1980) refers to as "man-made"– its masculinist heritage is foregrounded. This is evident across a range of disciplinary fields from physics to biology (Barad, 1995; Easlea, 1983; Keller, 1992, 1995; Haraway, 1989; Russett, 1992; Schiebinger, 1989, 1993; Spanier, 1995; Van Den Wijngaard, 1997). Covered with the cultural fingerprints of their creators, modern sciences are genealogies of the people and histories that have preceded us.

Science (mis)education

Science education research has attempted to examine what effects this culture-laden

nature of science has in the classroom. Empirically, study after study documents the suppressed levels of participation in both school science and science and science-related careers by women and ethnic minority group members (e.g. Kelly, 1987; Malcolm, 1990; National Science Foundation, 1988). Analyses examine such factors as teacher encouragement of students in the sciences, intervention programs, curricula, and students' views about science (Kahle & Meece, 1994; Stage, Kreinberg, Eccles, & Becker, 1985). A problem with this research, however, is that it tends to treat males and females as relatively unitary groups, overlooking the variety that exists within each of these categories. Just as there have always been some females who have excelled at science, there have been males who have been systematically excluded. Shifting out focus from the sex of the students to their genders is an important move. Examining more carefully these nuances is a necessary step towards re-visioning a different kind of science.

Many educational research studies have assailed the way in which science is taught in schools (e. g. Kahle, 1985). As Barton, *et al.* (1995) note, the traditional image of science as unemotional, detached and politically unbiased crumbled under feminist critique (p. 2). But this hasn't necessarily changed the ways of "doing science" in classrooms. Bentley and Watts (1987) noted that early attempts at crafting a feminine science emphasized that cooperation and collaborative work should be embedded in a relevant social context. In a similar manner, Rosser's (1990) assertion that "changing the competitive model upon which science is based could significantly change the social structure of science" could be extended to imagine what changing this model for interaction in school science could do. But are these innovations, aimed at specific groups of students enough?

Despite this research base, traditional views of science still predominate in schools (Driver *et* al., 1996; Jenkins, 1997; Lemke, 1990; McLaren & Gaskell, 1995), where science is still seen largely to serve the interests of a technocratic elite. Students still overwhelmingly view scientific claims as absolute, theories as unproblematic reflections of

the 'truths' in nature, and science to be an individual undertaking, done in isolation– the same characteristics that the feminist critiques of science have been deriding (Driver, Leach, Millar, & Scott, 1996). Many students, and often they are females, describe science as being very disconnected from their lives, as lacking real relevance to them (Costa, 1995; Rosser, 1990). I am concerned that the hegemonic masculinist nature of school science masks an insidious but largely invisible misogyny that is "one of the well-springs of our culture" (Smith, 1989, p. 207).

Schooling masculinities

Connell (1996) has summarized the "new research" on masculinities by noting that major conclusions from this burgeoning literature include: there are multiple masculinities; they exist in hierarchical relationships to one another and to other identity categories; they exist not only at the level of the individual, but also as a collectivity; they are composed of a "layering of desires, emotions, and logics" (p. 210); and they are rooted in certain histories, yet dynamic. Masculinity is not monolithic, nor does it signify a pre-existing, naturalized role that one adopts. What this work does more than anything else is problematize unitary, fixed notions of masculinities, in favor of highly complex, shifting and evolving portraits (e.g. Brod & Kaufman, 1994; Browne & Fletcher, 1995; Connell, 1995).

Schools are places where children actively take up gendered identities, though not always the identities that teachers and parents intend for them to take up, while learning to be members of social worlds (Davies, 1993). Schools are sites that shape and are shaped by a variety of masculinities (and femininities). Connell (1996) offers a useful analysis of the ways in which schools can function in two ways as "sites" for masculinity formation. In the first sense, schools can be viewed as an "institutional *agent*" of this process, and in the second, schools offer the setting within which other agencies, particularly those of the students, are at play.

The institution of schooling is constituted by and constitutes a "gender regime" (Connell, 1987; Kessler *et al.*, 1985), which is embodied through power relations, divisions of labor, patterns of emotion, and symbolization (Connell, 1996). It is through the interplay of these relationships that schools construct, deconstruct and reconstruct masculinities.

Because, "[m]asculinity shapes education as well as education forming masculinity" (Connell, 1989, p. 164), much recent work has focused on male students' constructions of masculinities and their (often deleterious) effects in classrooms. Our schools are places where certain masculinities are valued over others (Jordan, 1995; Skelton, 1996) and where polymorphous masculinities are enacted, refined, resisted, and deployed (Mac An Ghaill, 1994; Martino, 1997; Salisbury & Jackson, 1996; Willis, 1977; See also the other papers in this symposium). Within this range of masculinities 'available' in schools, certain versions are promoted and heralded, while others are devalued, ignored, or even erased (Askew & Ross, 1988; Davies, 1989, 1993; Gilbert & Taylor, 1991; Kenway, 1995; Mac an Ghaill, 1994; Thorne, 1993).

But even these identities are far from monolithic, as masculine identity intersects and interacts with the identity categories of "race" (Connolly, 1995; Majors & Billson, 1992), ethnicity (Mac an Ghaill, 1994), sexuality (Connell, 1992; Epstein, 1997; Hopkins, 1996; Kehily & Nayak, 1997; Mac an Ghaill, 1991; Nayak & Kehily, 1997; Pallotta-Chiarolli, 1995; Steinberg *et al.*, 1997), age, social class (Connell, 1993; Messner, 1996; Weis, 1995), friendship circles (Parker, 1996), family structure, and a host of other factors.

Those forms of masculinity with the greatest cultural cache, or whose deployment afford one access to greater shares of cultural capital, are hegemonic masculinities (Connell, 1985). Although these masculinities are the most visible, they are often times not the most numerous. And despite the fact that hegemonic masculinities by their very nature

victimize, silence, and oppress, it is important to heed Joan Smith's (1989) insistence that boys are the victims of these untruths just as much as girls.

School science and *certain* masculinities

Contrary to what many of us have been taught, neither science nor schooling are culture-free, objective, or value-neutral domains. As Rosenthal (1997) writes,

> science classrooms are truly multicultural. The cultures of the students and teacher, as well as the cultures of science and the academy influence not only the content of the course, but also the teaching and learning processes, interactions between instructor and students, verbal and non-verbal forms of communication, and observable behaviors. (p. 150).

The notion of cultures can not be overlooked in the science classroom This paper interrogates what this masculinized image and structure of science means to boys (and then by extension, to girls as well) in our science classrooms. Following Gilbert and Taylor (1991), we need to examine the context of the curriculum, but also the ways in which it is used.

Work has been done in schools on subjects ranging from English (Martino, 1994, 1995; Sanderson, 1995) to physical education (Parker, 1996; Skelton, 1993). But although the feminist critiques of science are well developed, little work has yet interrogated the ways in which school science models a middle class, academic masculinity of the mind, not of the body. It encourages competition through expertise rather than through physical confrontation (Connell, 1996).

As Connell (1989) notes about masculinity which is constructed in harmony with the general school curriculum, it stresses notions of responsibility and rationality, which can then eventually translate into social power that is centered abstract knowledge and authority. In a similar vein, Davies writes,

> Proper hard, non-subjective subjects like maths, science and technology provide a haven of acceptable (male) knowledges which confirm that true knowledge lies outside oneself, and independent of any subjectivities, independent of those emotions which need to be held in check. They are

> rational, cool, controllable, abstract, distant, and unquestionably hegemonic. (1995, p. 8).

This paper examines the notion that school science functions as a masculinizing practice (Connell, 1996) for the students who engage with it. As such, I view school science as actively implicated, both explicitly and implicitly, in Discourses (Gee, 1996) of hegemonic masculinity which may serve to empower a few, but undoubtedly debilitate, coerce, and mute many others.

I want to explore the idea that science, in this case school science, functions as a grand narrative that seduces certain students (Miller, 1991). I find this metaphor useful for envisioning the largely implicit ways in which school science may attract or repel certain students. For, as Jane Miller writes,

> for those who are seduced or governed or colonised or otherwise oppressed find themselves, through the processes of hegemony, validating their seducers or rulers or oppressors– indeed, cheering them on– through the self-fulfilling apparatus of a contract drawn up and underwritten by those in power (1991, p. 22).

The notion of seduction carries with it a whole set of relations based on identity categories– sex, sexuality, "race", ethnicity, social class, etc.– which have undoubtedly shaped and continue to shape realms of knowledge, such as school science. This metaphor also seems to be a powerful one in this context because it references the, "seductiveness of systems of thought whose origins and style are implicated in institutional exclusions of women" (Miller, 1991, p. 24).

What's going on in classrooms?

Using data gathered during elementary and middle school science lessons, I examine some of the often subtle ways in which school science serves to recapitulate a vision of and version of masculinity that is largely middle class [and one could rightfully also argue heterosexual and white]. Just as the literature around the formation and expression of working class masculinities stresses the primacy of the physical world

manifested through the body in coming to a true masculine identity, school science serves as a nice example to illustrate how a middle class version of masculinity focuses on the mind, rather than the body.

The first example is taken from a transcript of a sixth grade lesson in a unit on insects. In this lesson the students were investigating body characteristics and various behaviors of a large species of cockroach. Students worked in groups of four, and each group had a single cockroach that was about 5 centimeters long. This snippet is taken from one cooperative group.

> Ashley: Here, do you want it? [to Sam]
> Sam: No!
> Ashley: Take it- everyone has to.
> Carmen: Come on, just take it. She's holding it.
> [Ashley hands the roach to a visibly nervous Sam. After several seconds, the startled roach starts to run up Sam's arm, and in response he starts flailing his arms, sending the roach flying across the room].
> Ashley: Oh my god, what a baby!
> Lara: Sam!
> Mr. Wilton: [from across the room] Sam, grow up. It can't be that bad.

Sam is clearly not playing by "the rules". He is not eager for investigation (at least none that involves touching the roach) and when it becomes overwhelming for him, he is chastised rather than helped. Carmen intones that if a girl can hold the roach, then Sam certainly can. This is a very common (misogynist) put-down strategy used against boys– surely there can be nothing worse than being referred to as a girl (Hopkins, 1996). And in this case, Sam appears unwilling (unable?) to do what a girl is seemingly doing quite easily – an even bigger put-down. And although its not clear if he chose to hold the roach or just succumbed to peer pressure, the end result was less than powerful science for Sam. He is derided for being immature (a "baby" who needs to "grow up"). He is not acting in a way that is deemed appropriate for science class. What is implicit in these criticisms is that Sam is failing to use his mind (the cornerstone of modern Western science) to exert control over nature (manifested here as a roach), and is therefore in the dubious position of falling

'victim' to his emotions. If he were really 'doing science'– the mantra goes– he would tame the matter , his emotions wouldn't tame him.

The next segment of dialogue comes from an end of the unit assessment in a first grade classroom. The teacher is meeting with each student individually at the conclusion of a sinking and floating unit to do some individualized performance assessment. This scene takes place between the teacher, Ms. Renfrew, and Taurence as they sit at a table in the back of the classroom with a tray of objects and a tub of water.

Ms. R: Find the penny. Do you think that will sink or float?
T: Sink.
Ms. R: Would you like to try it?
T: [Drops penny into tub of water]
Ms. R: Were you right?
T: [Nods head].
Ms. R: You were right! Great job! Find the ball of clay. Do you think it will sink or float?
T: Float [Drops it in]. Awww
Ms. R: Were you right? What did it do?
T: [Shakes head]. It sank.
Ms. R: It sank. Good try though. Find the string. Do you think it will sink or float?
T: Float. [Drops it in the water]. Float!
Ms. R: Were you right?
T: Yeah.
Ms. R: Wow! Good job. Find the plastic bottle. What do you think it will do?
T: Float [Drops in]
Ms. R: What did it do?
T: Floated.
Ms. R: Were you right?
T: Yeah.
Ms. R: Good for you. Find the bottle top. What do you think its going to do?
T: Sink
Ms. R: Let's find out.
T: Awww [It floats]
Ms. R: Was your prediction right or wrong?
T: Wrong
Ms. R: Wrong. Good try. Good try. Could you find the twist tie? What do you think it's going to do?
T: Float
Ms. R: OK [Taurence puts it in the water]
T: Sink!
Ms. R: Oh boy! Now I thought that was a floater too. Good try.

Several things appear to be going on here. First, the point of this activity, an end of the unit assessment, seems to be guessing correctly. Taurence is never asked for evidence or reasoning to back up his predictions. He just calls them out and rushes on to test them. Its the answer that matters, not why he thinks it is so. The focus seems to be on a masculinist discourse of objectivity, with the sinking and floating objects acting as the divining rod for that objectivity. By simply placing each object into the water, the "truth" about its subsequent sinking or floating is revealed. And the focus of the activity seems to be whether or not he has predicted (guessed) correctly for each object. The activity seems to be all about "right" answers, though Taurence is still praised for guesses that turn out to be incorrect ("good try"); and at one point, perhaps to make him feel better because he had gotten several predictions "wrong", the teacher admits that she too thought that the twist tie "was a floater". Was the purpose of this assessment activist to try to baffle the students? To try to catch them off guard, predicting incorrectly? It is never clear.

I also wonder to what extent the science being done (and the teacher helping to do it) are complicit in silencing Taurence both by conversations foreclosed and words never mentioned (Fine, 1989). He is not pressed (or even asked) to offer evidence or reasons for his predictions about sinking and floating. Instead, he simply picks a choice from a dichotomy, in a task that could be vary far removed from the "big ideas" in science that it appears that the entire unit, and certainly this assessment are trying to build understanding around.

The next segment of dialogue comes from a cooperative group of four students in a fourth grade classroom studying materials and their properties. The four students were charged with coming to consensus about what the results of various tests tell them about the fabric they were investigating.

Amy: What did you get Rachel?
Matt: I think that its not very durable, but that its strong and water-proof.
Amy: Rachel?

Rachel: It looks like its medium-durable....
Malik: Medium?
Rachel: Yeah, it lasted nine strokes [of the fabric along a concrete surface] before it got a hole.
Matt: So why is that medium?
Amy: [under her breath] What else could it be?
Rachel: Because it could be more or it could be less...
Matt: Nine strokes is not very durable
Malik: Yeah. What about water-proof?
Rachel: I'm not sure...
Matt: It's definitely water-proof
Amy: Why?
Matt: Did you pay attention to the test?
Amy: Yes. I did. I thought it was getting a wet spot.
Rachel: I think it was too.
Malik: I didn't see it. Let's say its water-proof.
Matt: Yeah.
Amy: And strong
Matt: Of course!
Ms. Chanson: How are you making out over here?
Matt: Fine. It's strong and water-proof and not very durable.
Ms. Chanson: Super. Be ready to talk about that when we report out.

This snippet of classroom talk offers us an important view of consensus-building in cooperative groups as they relate to issues of power and authority in the classroom. Just because the idea of students working in groups seems to start to equalize the power dynamic in the classroom, and just because groups offer the potential for students to work collaboratively in an egalitarian fashion, does not mean that this will happen. As the empirical literature base tells us, and the above example demonstrates, just because students are in a group doesn't mean they will work together; just because they're supposed to share decision-making responsibilities doesn't mean that they will; just because they each have a specific role within the group doesn't mean they'll perform it. Groups, as microcosms of the larger society within which they are formed, run the risk of falling prey to the same exclusionary social practices of homophobia, sexism, classism, racism, etc. that the larger society exhibits. In the instance above, Matt seemed little interested in reaching consensus. His goal seemed to be to assert his power by making his opinions (in the form of his experimental results) heard. This occurred to a large extent at the expense of Amy and Rachel's ideas and interpretations. Although the group seems to be working to consensus,

when the teacher comes by, Matt asserts his own opinions about the results as if he is speaking for the members of his group. He is not.

In group interactions, these points are particularly salient around the issue of language. As Trinh (1989) writes, "language is one of the most complex forms of subjugation, being at the same time the locus of power and unconscious servility" (p. 52). Just because students are talking does not mean they aren't dominating, silencing and dismissing one another, playing out time honored societal scripts where the oppressors maintain power. Talking is not a neutral activity; it is, as described earlier, a mediational tool through which students construct meaning. But it doesn't offer us clues about what meaning is being constructed. The same talk that could be used to better understand a science concept could simultaneously be reinforcing classroom norms of submissiveness, obedience, or in this case, hegemonic masculinity. "Students may have opportunities for group work, " writes Ladson-Billings, "but what teachers deem cooperative behavior more accurately falls under the category of compliance or conformity" (1994b, p. 70). So the issues of power, authority and language that infuse the grouping approach to science pedagogy must be better theorized and articulated to ensure that grouping does not degenerate into yet another form of hegemonic subjugation of the students in the classroom.

The final vignette is from a fifth grade classroom studying structures of life. The teacher is leading the class in a discussion about what they have been observing about crayfish behavior.

Mr. Axe: So, from all that you've observed over the last two classes, what do you think about the question of territoriality? Are crayfish territorial?
[Class collectively calls out answers, mostly 'yes']
Mr. Axe: Preston?
Preston: Ours were.
Mr. Axe: OK. Ginger?
Preston: But...
Ginger: No.

Mr. Axe: No?
Ginger: Well, yes.
Mr. Axe: Yes? No, yes which one is it?
[Silence from Ginger]
Mr. Axe: What were you observing for to determine if they were territorial or not?
Ginger: They were.
Alison: Yeah, they were.
Mr. Axe: OK, Ginger, why are you saying yes.
Ginger: Because Alison just whispered that to me, and she's really good in science.
[Laughter from some of the class, some kids roll their eyes]
Mr. Axe: But what do you think Ginger?
Ginger: I agree with Alison.
Mr. Axe: Why?
Ginger: 'Cause she knows what she's doing.
Mr. Axe: Any other reasons for why you think this way?
Ginger: I agree with my group. They say they were territorial, I agree.
Mr. Axe: But I want to know <u>why</u> you think so
Ginger: 'Cause...

Again, although this incident largely centers on a female pupil, it delivers a strong message about the role of authority in science. Although she might have been a disinterested student, it seems that although Ginger had been participating in science, she appealed to authorities (Alison, who's "really good in science", and her cooperative group) to answer questions. Initially Ginger answered the teacher's question with a 'no', but he questioned that response, possibly leading Ginger to believe that it was an incorrect answer. But she immediately distances her own opinion (based on what she has been observing in class) and relies on the answers from more knowledgeable (at least in Ginger's eyes) others. Underlying this deference to authority is a power dynamic that Ginger seems to succumb to. Instead of defending her answer, she seems to back down and to offer forward the answer of another, "an other" that she constructs as having authority in science. We need to interrogate the notion that this type of group work set-up can foster consensus without coercion in the classroom. And with this authority comes power, evidenced here by the way that Ginger invokes these authorities to exploit their very power to successfully answer the teacher's question. This scenario also gestures towards the possible ways in which peer interactions in science working groups can be debilitating for some students.

Future visions

First, when examining the issues surrounding hegemonic masculinities and school science, I think it is important to echo Connell's caution that, "Boys are not, as boys, a disadvantaged group, and the goal of educational work therefore is not to redress a gender disadvantage from which they suffer" (1996, p. 223). Viewing boys as disadvantaged unnecessarily reinscribes the false dichotomy between boys and girls and sets up an oppositional dynamic (Kenway, 1995; Yates, 1997). Instead, this project has been about examining the ways in which school science can perpetuate certain hegemonic masculinities that disadvantage both girls and boys. Thus, the focus of this work has been an uncovering of some of the ways in which this perpetuation can occur within classrooms.

Schools are undoubtedly the sites of cultural production and reproduction, where students conform, resist, negotiate, and contest identities. I argue that school science should offer more resources to engage in this struggle. School science should work to actively refute the ideology that school science equals hegemonic masculinity. I agree with Sharon Haggerty (1996) that we can't ignore issues of how science is represented in schools, and in its interactions with gender. Left unexamined, these beliefs would most likely simply perpetuate themselves in a vicious cycle, as they have for decades. Instead, we need to start to view schools, and specifically in this case school science, as sites of intervention, and as offering possibilities for re-viewing gendered, racialized, classed, and sexualized subjectivities.

I think it is worth exploring the possible ways in which a girls/boys dichotomy used in science education research, as well as countless other fields, may oversimplify reality and in fact reinforce the prominence of science as a masculinist regime of truth . This false dichotomy certainly homogenizes all boys (Martino, 1997; Pallotta-Chiarolli, 1997), erasing many who do not embrace, or fit, hegemonic masculinities. As Smith (1991) poignantly reminds us, this dichotomizing is intricately bound up in a cultural

proclivity for misogyny, and this, Epstein (1997) insists, is further reinscribed with homophobias and compulsory heterosexuality. There is a great deal of unpacking that needs to be done around these concepts and their many faces within schools.

A call for change

I conclude with some implications for our science classrooms, both in terms of the structure of the school science curriculum and the pedagogies used to convey that curriculum. Changing pedagogy, no matter how equitable it becomes, without fundamentally changing the masculinist, racist, classist, homophobic, hegemonic structure of science is merely applying a superficial dressing to a very deep wound. The most democratic, equitable, and inclusive classroom imaginable will not affect transformative education if the subject of study is structured by the exact opposite tendencies. Bentley and Watts (1987) note that school science should be re-examined, reshaped, and redefined in terms of the views it has of people in science so that it better reflects to diverse populations that it is serving. Similar calls are issued by educators (Brickhouse, 1994; Hodson, 1993; Stanley and Brickhouse, 1994) and philosophers (Harding, 1998). Stanley and Brickhouse (1994) caution that, "excessively narrow definitions of what science is (e.g., science is what Western scientists have produced during the last 200 years) is too exclusionary of multiple perspectives and is ultimately detrimental to both science education and to science. Multiple perspectives should be seen as a rich resource for science and science education" (p.395). Not until we de-center the hegemonic masculinist position of school science as we now teach and learn it can this hope become a reality.

But changing school science is not enough, although it would help, because to a greater or lesser extent much of school science is structured and practiced like 'real' science. The call here, offered despite the tremendous structural, social and cultural obstacles, is to radically transform science. A more inclusive definition of science can yield (though it is important to note that it does not ensure this will occur) a more inclusive and

democratic science education, one which brings in the outsiders (Brickhouse, 1994). Because schools are sites of cultural reproduction where students conform, resist, negotiate, and contest identities, I argue that school science should offer more resources to engage this struggle. Schools must refute the ideology that school science equals hegemonic masculinity. We need to view schools, and specifically in this case school science, as a site of intervention and of re-viewing gendered subjectivities. A critical reassessment of the gender regimes reinscribed by and propagated through school science could mean that school science could perhaps one day function as a critical counterdiscourse to hegemonic masculinity. Perhaps it could even function to create counternarratives to the status quo in science (Giroux, Lankshear, McLaren, & Peters, 1996). That time is now.

REFERENCES

Askew, S. & Ross, C. 1988. *Boys don't cry: Boys and sexism in education.* Philadelphia: Open University Press.

Barad, K. 1995. A feminist approach to teaching quantum physics. In S. Rosser (Ed.), *Teaching the majority: Breaking the gender barrier in science, mathematics, and engineering.* New York: Teachers College Press, 43-75.

Barton, A. C., Cavazos, L., Hazelwood, C., Howes, E., Kurth, L., Richmond, G., Roth, K., & Smith, D. 1995, April. Exploring the role of self in science and science education: Feminist perspectives and women's stories. Paper presented at the annual meeting of NARST, San Francisco.

Bentley, D. & Watts, M. 1987. Courting the positive virtues: A case for feminist science. In A. Kelly (Ed.), *Science for girls?* Philadelphia: Open University Press, 89-98.

Brickhouse, N. 1994. Bringing in the outsiders: Reshaping the sciences of the future. *Journal of Curriculum Studies*, 26(4), 401-416.

Brod, H. & Kaufman, M. (Eds.) 1994. *Theorizing masculinities.* London: Sage Publications.

Browne, R. & Fletcher, R. (Eds.) 1995. *Boys in schools: Addressing the real issues– behaviour, values and relationships.* Sydney: Finch Publishing.

Bryson, M. & de Castell, S. 1994. So we've got a chip on our shoulder! Sexing the texts of "educational technology". In J. Gaskell & J. Willinsky (Eds.), *Gender in/forms the curriculum from enrichment to transformation.* New York: Teachers College Press, 21-42.

Connell, R. W. 1987. *Gender and power.* Cambridge: Polity Press.

Connell, R. W. 1989. Cool guys, swots and wimps: The interplay of masculinity and education. *Oxford Review of Education*, *15*(3), p.

Connell, R. W. 1992. A very straight gay: masculinity, homosexual experience and the dynamics of gender. *American Sociological Review*, *57*, p. 735-751.

Connell, R. W. 1993. Disruptions: Improper masculinities and schooling. In L. Weis & M. Fine (Eds.), *Beyond silenced voices: Class, race, and gender in United States schools.* Albany: State University of New York Press.

Connell, R. W. 1995. *Masculinities.* Berkeley: University of California Press.

Connell, R. W. 1996. Teaching the boys: New research on masculinity, and gender strategies for schools. *Teachers College Record*, *98*(2), 206-235.

Connolly, P. 1995. Boys will be boys? Racism, sexuality, and the construction of masculine identities amongst infant boys. In J. Holland & M. Blair, with S. Sheldon (Eds.), *Debates and issues in feminist research and pedagogy.* Philadelphia: Open University Press, 169-195.

Costa, V. B. 1995. When science is "another world": Relationships between worlds of family, friends, school, and science. *Science education*, *79*(3), 313-333.

Davies, B. 1989. *Frogs and snails and feminist tales: Preschool children and gender.* Sydney: Allen & Unwin.

Davies, B. 1993. *Shards of glass: Children reading and writing beyond gendered identities.* Sydney: Allen & Unwin.

Davies, B. 1995. What about the boys? The parable of the bear and the rabbit. *Interpretations*, *28*(2), 1-17.

Driver, R., Asoko, H., Leach, J., & Scott, P. 1994. Constructing scientific knowledge in the classroom. *Educational Researcher, 23*, 5-12.

Driver, R., Leach, J., Millar, R., & Scott, P. 1996. *Young people's images of science.* Buckingham: Open University Press.

Easlea, B. 1983. *Fathering the unthinkable: Masculinity, scientists and the nuclear arms race.* London: Pluto Press.

Epstein, D. 1997. Boyz' own stories: Masculinities and sexualities in schools. *Gender and Education*, *9*(1), p. 105-115.

Fine, M. 1987. Silencing in public schools. *Language Arts*, *64*(2), 157-174.

Foucault, M. 1980. *Michel Foucault: Power/knowledge: Selected interviews and other writings 1972-1977*. C. Gordon (Ed.). Sussex: Harvester.

Gee, J. P. 1996. *Social linguistics and literacies: Ideology in discourses*. London: Taylor and Francis.

Gilbert, P. & Taylor, S. 1991. *Fashioning the feminine: Girls, popular culture and schooling*. Sydney: Allen & Unwin.

Giroux, H. A., Lankshear, C., McLaren, P., & Peters, M. 1996. *Counternarratives: Cultural studies and critical pedagogies in postmodern spaces*. New York: Routledge.

Haggerty, S. M. 1996. Towards a gender-inclusive science in schools: Confronting student teachers' perceptions and attitudes. In Parker, L. H., Rennie, L. J. , & Fraser, B. J. (Eds.) *Gender, science and mathematics: Shortening the shadow*, pp. 17-27. Dordrecht: Kluwer Academic Publishers.

Haraway, D. 1989. *Primate visions: Gender, race, and nature in the world of modern science*. New York: Routledge.

Harding, S. 1986. *The science question in feminism*. Ithaca, NY: Cornell University Press.

Harding, S. 1991. *Whose science? Whose knowledge?: Thinking from women's lives*. Ithaca, NY: Cornell University Press.

Harding, S. (Ed.) 1993. *The 'racial' economy of science: Toward a democratic future*. Bloomington: Indiana University Press

Harding, S. 1998. *Is science multicultural? Postcolonialisms, feminisms, and epistemologies*. Bloomington: Indiana University Press.

Hodson, D. 1993. In search for a rationale for multicultural science education. *Science education*, *77*, 685-711.

Hopkins, P. D. 1996. Gender treachery: Homophobia, masculinity, and threatened identities. In L. May, R. Strikwerda, & P. D. Hopkins (Eds.), *Rethinking masculinity: Philosophical explorations in light of feminism*. Boulder: Rowan & Littlefield, 95-115.

Jenkins, E. 1997. Towards a functional public understanding of science. In R. Levinson & J. Thomas (Eds.), *Science today: Problem or crisis?* New York: Routledge, 137-150.

Jordan. E. 1995. Fighting boys and fantasy play: The construction of masculinity in the early years of school. *Gender and Education*, *7*(1), p. 69-86.

Kahle, J. B. (Ed.). 1985. *Women in science: A report from the field*. Philadelphia: Falmer Press.

Kahle, J. B. & Meece, J. 1994. Research on gender issues in the classroom. In Gabel, D. (Ed.) *Handbook of research in science teaching and learning* (pp. 542-576). Washington, DC: National Science Teachers Association.

Kehily, M. & Nayak, A. 1997. Lads and laughter: Humour and the production of heterosexual hierarchies. *Gender and education*, *9*(1), p. 69-87.

Keller, E. F. 1985. *Reflections on gender and science*. New Haven: Yale University Press.

Keller, E. F. 1992. *Secrets of life, secrets of death: Essays on language, gender, and science*. New York: Routledge.

Keller, E. F. 1995. *Refiguring life: Metaphors of twentieth century biology*. New York: Columbia University Press.

Kelly, A. (Ed.). 1987. *Science for girls?* Philadelphia: Open University Press.

Kenway, J. 1995. Masculinities in schools: Under siege, on the defensive and under reconstruction? *Discourse: Studies in the cultural politics of education*, *16*(1), p. 59-79.

Kessler, S., Andersen, D. J., Connell, R. W. & Dowsett, G. W. 1985. Gender relations in secondary schooling. *Sociology of education*, *58*, p. 34-48.

Ladson-Billings, G. 1994. *The Dreamkeepers: Successful teachers of African*

American children. San Francisco: Jossey Bass.

Lemke, J. L. 1990. *Talking science: Language, learning and values*. Norwood, NJ: Ablex Publishing Corporation.

Mac An Ghaill, M. 1991. Schooling, sexuality and male power: Towards an emancipatory curriculum. *Gender and education, 3*(3), p. 291-309.

Mac An Ghaill, M. 1994. *The making of men: Masculinities, sexualities, and schooling*. Milton Keyes: Open University Press.

Majors, R. & Billson, J. M. 1992. *Cool pose: The dilemmas of Black manhood in America*. New York: Simon & Schuster.

Malcolm, S. M. 1990. Who will do science in the next century? *Scientific American, 262*(Feb.), 112.

Martino, W. 1994. Masculinity and learning: Exploring boys' underachievement and under-representation in subject English. *Interpretations, 27*(2), p. 22-57.

Martino, W. 1995. It's not the way guys think! In R. Browne & R. Fletcher (Eds.), *Boys in schools: Addressing the real issues– behaviour, values and relationships*. Sydney: Finch Publishing, 124-138.

Martino, W. 1997. Boys in schools: Addressing the politics of hegemonic masculinities. Paper presented at the annual meeting of the Australian Association of Research in Education, Brisbane, QLD, 30 November-4 December.

McLaren, A. & Gaskell, J. 1995. Now you see it, now you don't: Gender as an issue in school science. In J. Gaskell & J. Willinsky (Eds.), *Gender in/forms the curriculum from enrichment to transformation*. New York: Teachers College Press, 136-156.

Merchant, C. 1980. *The death of nature: Women, ecology and the scientific revolution*. New York: Harper Collins.

Messner, M. A. 1996. Masculinities and athletic careers. In E N-L Chow, D. Wilkinson, & M. B. Zinn (Eds.), *Race, class, and gender: Common bonds, different voices*. London: Sage Publications.

Miller, J. 1991. *Seductions: Studies in reading and culture*. Cambridge: Harvard University Press.

National Science Foundation. 1988. *Women and minorities in science and engineering*. NSF 88-301, Washington, DC: NSF.

Nayak, A. & Kehily, M. 1996. Playing it straight: Masculinities, homophobias, and schooling. *Journal of gender studies, 5*(2), p. 211-230.

Pallotta-Chiarolli, M. 1995. Can I use the word gay? In R. Browne & R. Fletcher (Eds.), *Boys in schools: Addressing the real issues– behaviour, values and relationships*. Sydney: Finch Publishing, 66-80.

Parker, A. 1996. The construction of masculinity within boys' physical education. *Gender and Education, 8*(2), p. 114-157.

Rosenthal, J. W. 1997. Multicultural science: Focus on the biological and environmental sciences. In A. I. Morey & M. K. Kitano (Eds.), *Multicultural course transformation in higher education*. Boston: Allyn & Bacon, 145-160.

Rosser, S. V. 1990. *Female friendly science: Applying women's studies methods and theories to attract students*. New York: Teachers College Press.

Russett, C. E. 1992. *Sexual science: The Victorian construction of womanhood*. Cambridge, MA: Harvard University Press.

Salisbury, J. & Jackson, D. 1996. *Challenging macho values: Practical ways of working with adolescent boys*. London: Falmer Press.

Sanderson, G. 1995. Being *cool* and a reader. In R. Browne & R. Fletcher (Eds.), *Boys in schools: Addressing the real issues– behaviour, values and relationships*. Sydney: Finch Publishing, 152-167.

Schiebinger, L. 1989. *The mind had no sex? Women in the origins of modern science*. Cambridge, MA: Harvard University Press.

Schiebinger, L. 1993. *Nature's body: Gender in the making of modern science*. Boston: Beacon Press.

Skelton, A. 1993. On becoming a male physical education teacher: The informal culture of students and the construction of hegemonic masculinity. *Gender and Education*, *5*(3), p. 289-303.

Skelton, C. 1996. Learning to be tough: The fostering of maleness in one primary school. *Gender and Education*, *8*(2), p. 185-197.

Smith, J. 1989. *Misogynies*. London: Vintage.

Spanier, B. B. 1995. *Im/partial science: Gender ideology in molecular biology*. Bloomington: Indiana University Press.

Spender, D. 1980. *Man-made language*. London: Routledge & Keegan Paul.

Stage, E. K., Kreinberg, N., Eccles, J., & Becker, J. R. 1985. Increasing the participation and achievement of girls and women in mathematics, science, and engineering. In Klein, S. S. (Ed.) *Handbook for achieving sex equity through education*. Johns Hopkins University Press.

Stanley, W. B. & Brickhouse, N. W. 1994. Multiculturalism, universalism, and science education. *Science Education*, *78*(4), p. 387-398.

Steinberg, D. L., Epstein, D. & Johnson, R. 1997. *Border patrols: Policing the boundaries of heterosexuality*. London: Cassell.

Thorne, B. 1993. *Gender play: Girls and boys in school*. New Brunswick: Rutgers University Press.

Trinh, Minh-ha T. 1989. *Woman, native, other: Writing postcoloniality and feminism*, Bloomington: Indiana University Press.

Van Den Wijngaard, M. 1997. *Reinventing the sexes: The biomedical construction of femininity and masculinity*. Bloomington: Indiana University Press.

Weis, L. 1995. Constructing the "other": Discursive relations of white working-class males in high school. In P. L. McLaren & J. M. Giarelli (Eds.), *Critical theory and educational research*. Albany: State University of New York Press.

Willis, P. 1977. *Learning to labour: How working class kids get working class jobs*. Hants: Saxon House.

Yates, L. 1997. Gender equity and the boys debate: What sort of challenge is it? *British Journal of Sociology of Education*, *18*(3), p. 337-347.